REMARKS

The title and abstract have been revised as recommended in the office action. In addition, several passages in the specification have been either deleted, amended, or rewritten as was required in the office action. With respect to the referencing the prior US and PCT applications, the undersigned notes that the preliminary amendment filed with the application makes this amendment on page 2.

Claim 22 has been canceled without prejudice as being drawn to a non-elected invention. Claims 9-15, 18-19, and 25-28 have been amended and are the only claims remaining in the application.

Claim 9 has been amended to specify 2 Li+ as noted in the office action, and this revision overcomes the objections and rejection under 35 U.S.C. 112, second paragraph. Claims 20 and 24 have been canceled thereby making moot the objections and rejections of these claims.

All claims have been amended to specify a fertilizer or soil conditioner preparation. As noted in the office action, as originally filed, some claims specified an "LDH", some specified a "mixture", and some specified a "preparation". This amendment consolidates that claims in a manner more suited to US practice . In addition, proper line indentations have been used in claims 9 and 18.

Claim 15 now properly depends from claim 9; thus overcoming the rejection under 35 U.S.C. 112, second paragraph.

The office action presents an analysis of the independent claims. The claims have been revised extensively to conform the claimed subject matter to a fashion more appropriate for U.S. practice, and to simplify issues for prosecution. Layered double hydroxides (LDHs) are know as anionic clays because of their lamellar structure with exchangeable anions in the interlayers. LDHs are also referred to as "hydrotalcite-like" or "pyroaurite-like" because of the natural minerals, hydrotalite and pyroaurite which contain carbonate as anion in the interlayer.

LDHs can be used as anion exchangers to remove chromates from waste water or silicates from industrial boiler systems (see Clarke, EP0207707A2), as an

antacid in pharmaceuticals (see Schneider and Knecht, EP 040 521 B1), as a stabilizer of halogen containing polymers such as polyethlyene and polypropylene (see Miyata and Kuroda DE 2950489 C2), as a catalyst for chemical reactions (see Reichle, U.S. Patent 4,458,026, and Drezdzon, U.S. Patent 4,483,168) or as a flame retardant (see Cavani, "Hydrotalcite-type Anionic Clays, Preparation; Properties and Applications, (1991), Wada and Masuda, "Control of Salt Concentration of Soil Solution by the Addition of Synthetic Hydrotalcite", *Soil Sci. Plant. Nutri.* 41:3770381 (which reported that hydrotalcite, a carbonate saturated LDH, may be used as a salt buffer in greenhouse soils with high calcium concentration–the aim of the application of hydrotalcite was to reduce salt concentration in the soil solution by precipitation of calcium carbonate at pH 7.0 or greater, but the hydrotalcite did not retain nitrate or other anions from leaching).

No prior art is known or identified in the office action which demonstrates LDH being used as a slow release fertilizer and a long-term soil conditioner. The synthetic LDHs of this invention are composed of two different metal hydroxides. The brucite-like main layer consists of a divalent metal hydroxide as well as a trivalent metal hydroxide. The main layer is positively charged because of the isomorphic substitution of the divalent ion by the trivalent ion. The positive charge is neutralized by anions between the two sheets. This interlayer also contains water. The general formula is

$$[M^{2+}_{1-x}M^{3+}_{x}(OH)^{-}_{2}]^{x+}(A^{n-}_{x/n})\bullet mH_2O$$

with M^{2+} being for example Ca^{2+} or Mg^{2+}, M^{3+} being for example Fe^{3+} or Al^{3+}, and A^{n-}being for example NO_3^-, Cl^-, SO_4^{2-}, or HCO_3^-. The amount of isomorphic substitution of M^{2+} and M^{3+} (x) is expressed as

$$x=[M^{2+}]/([M^{2+}] + [M^{3+}])$$

The inventive LDH structure exists at x in the range of 0.1 to 0.5. The crystallinity of LDH depends on several factors such as the used divalent and trivalent cations, the isomorphic substitution, the temperature during precipitation, the pH, the reaction rate, and the temperature and pressure during hydrothermal treatment.

Claims 12 and 13 and 14 particularly highlight the fact that the claimed invention is a fertilizer and soil conditioner by requiring the presence of other fertilizers, seeds, seedlings or propagation elements.

Claims 9-11, 18, 20, 21, 23, 24, and 26 was rejected as being anticipated by GB1336864. This rejection is traversed. At the outset, the metal hydroxides of GB 1 334 864 are used for magnets, absorbing substances, dehydrating agents, pigments or catalysts. GB 1 334 864 does not disclose or suggest use as a fertilizer or soil conditioner. The composite metal hydroxides of GB 1 334 864 are fundamentally different from the claimed LDH of the present application. The layered LDH of the claimed invention comprises exchangeably bound anions in the intermediate layers. The anions in GB 1 334 864 are limited to being divalent, whereas the anions in the LDH of the present invention are n– valent, and claim 9 sets forth properties of the anions which are different from those presented in GB 1 334 864. Furthermore, the construction of the claimed preparation permits the LDH to be used as fertilizers and soil conditioners for the uniform supplying of arable land with nitrogen. In contrast, the metal hydroxides of GB 1 334 864 are strictly limited to a magnesium metal, whereas the present invention permits the LDH to employ several metals which are different from magnesium and which have different physical properties and exchange characteristics from magnesium.

Claims 9-11, 18, 20, 21, and 23-28 were rejected as being either anticipated by or being obvious over Hansen. This rejection is traversed.

In Hansen, the synthesis of LDHs containing anions different from CO_3^{2-} is problematic due to contamination of CO_2 from the atmosphere or CO_3^{2-} present in chemicals used for precipitation. Hansen shows that the strong increase in C in LDH is accompanied by a small increase of carbonate in solution. This indicates that carbonate and hydrogen carbonate are preferred over nitrate in the interlayer in Hansen. At 0.15 M carbonate, virtually no nitrate was intercalated in the LDH, although the solution contained 15 times high nitrate concentration of 2.3M. Unlike the present invention, Hansen does not teach a LDH with a slow release fertilizer and a long term soil conditioner. The LDH of the claimed invention adsorbs nitrate from the soil to prevent nitrate leaching into deeper soil layers. In contrast, Hansen teach that carbonate can be exchanged against nitrate using glycerol as a solvent.

Claims 9, 10, 18, 20, 21, 23, 24, 26, and 28 have been rejected as being anticipated by meixnerite described in U.S. Patent 5,514,361 to Martin. Claims 9-11, 18, 20, 21, and 23-28 were rejected as being either anticipated by or obvious

over U.S. Patent 5,728,363 to Martin. Both rejections are traversed in view of the amendments above. As noted above, neither Martin reference is directed to a fertilizer or soil conditioner. In addition, the meixinerite mentioned in column 1 of the first Martin patent does not include an anion such as nitrate, sulfate, or chloride. Martin does not disclose the exchangeable bound anions in the intermediate layers contemplated by this invention. Furthermore, Martin does not show or suggest a compound following within the general formula of claim 9 where x ranges from 0.1 to 0.5.

U.S. Patent 5,514,361 to Martin relates to a method for making synthetic meixnerite. The meixnerite, or magnesium aluminum hydroxide hydrate, is often symbolized by the formula $Mg_6Al_2(OH)_{18}\cdot 4H_2O$. In contrast, the LDH used in the fertilizer and soil conditioner of the claimed invention is fundamentally different from meixnerite. These differences are shown in the general formula:

$$[M^{2+}_{1-x}M^{3+}_{x}(OH)^{-}_{2}]^{x+}A^{n-}_{x/n}\cdot mH_2O$$

Meixnerite has no intermediate layers as well as exchangeable bound anions A^{n-} in the intermediate layers.

The synthesis of LDHs containing anions different to CO_3^{2-} is problematic due to contamination of CO_2 from the atmosphere or CO_3^{2-} present in chemicals used for precipitation. For instance, Hansen et al., "The use of glycerol intercalates in the exchange of CO_3^{2-} with SO_4^{2-}, NO_3^- or Cl^- in pyroaurite-type compounds" (1991), Clay Minerals 26:311-327 shows that the strong increase in C in LDH is going with a small increase of carbonate in solution. This indicates that carbonate and hydrogen carbonate is preferred over nitrate in the interlayer. At 0.15M carbonate, virtually no nitrate has intercalated in the LDH, although the solution contained a 15 times higher nitrate concentration of 2.3M.

The aim of Martin is not to teach a LDH with a slow release fertilizer and a long-term soil conditioner. Martin teaches using the activated alumina and magnesium oxide, pelletized MgO and activated alumina or magnesite and activated alumina. In sharp contrast the LDH used in the fertilizer and soil conditioner of the invention needs to fulfill the following criteria:

1. The mineral has to buffer the nitrate concentration in the soil solution. This means the mineral absorbs nitrate if the nitrate concentration in the soil is high after fertilization and mineralization, and the mineral should release nitrate if

the crops require N.

2. The mineral has to be selective for nitrate over counter ions, such as sulphate, chloride, or phosphate, which are also supplied to the soil in large quantitites.

3. The anion exchange capacity has to be high and independent of pH.

4. The mineral must be stable for several years in the soil.

5. The mineral must be harmless to the environment.

The complexity of these problems makes it clear that U.S. Patent 5,514,361 to Martin does not lead to or suggest the claimed invention. Moreover, Martin would not be relevant to a person of ordinary skill in the art which is to be solved by the above mentioned criteria.

U.S. Patent 5,728,363 to Martin describes a method for making a layered double hydroxide powder based on hydrotalcite and hydrotalcite-like compounds. Martin shows uses for acid neutralizers and scavengers, especially for polypropylene and polyethylene manufacturers, adsorbents for heavy meatal anions from waste water, sabilizing components for other polymer systems such as polyvinyl chloride, flame retarders, smoke suppressers, catalyst supports and viscosity control agents. Martin is aimed at providing an improved means for making synthetic hydrotalcite-like compounds from two or more relatively inexpensive dry powder components. Martin is not focused on and does not suggest a fertilizer and soil conditioner, and does not address any of the five criteria noted above.

Claims 9-11, 18, 20, 21, and 23-28 were rejected as being anticipated by or being obvious over U.S. Patent 4,773,936 to Clark. The rejection is traversed. The Clark reference is directed to water insoluble pigment comprising a complex of a water-insoluble inorganic substrate exhibiting anion exchange properties, a water-soluble dye, and an anionic amphipathic material. Clark is not directed to a fertilizer or soil conditioner as is required in the claimed invention. Clark does not disclose the exchangeable bound anions in the intermediate layers contemplated by this invention. Furthermore, Clark does not show or suggest a compound following within the general formula of claim 9 where x ranges from 0.1 to 0.5.

Claims 9, 10, 18, 20, 21, 23, 24, 26, and 28 have been rejected as being obvious over JP 5-317603 to Narita (the undersigned thanks the Examiner for the

translation). This rejection is traversed. Narita discloses use of an LDH to remove chronium from soil which has been contaminated with chronium (VI) acid ion. This is quite different from the task of being a fertilizer and soil conditioner. Furthermore, Narita does not show or suggest any details with respect to the value of x in the structural formula, and Claim 9 has been amended to set forth specific ranges.

Claims 9-11, 18, 20, 21, and 23-28 have been rejected as being obvious over WO 96/23727A1 to Diblitz in view of U.S. Patent 6,180,764 to Noweck. This rejection is traversed. Diblitz shows the use of hydrotalcites as catalysts, ceramics, ion exchangers, additives for plastics, and pharmaceuticals. Diblitz contains no teaching or suggestion for using LDHs as fertilizers and soil conditioners. Furthermore, Noweck, which shows a method of producing hydrotalcites and does not suggest application as a fertilizer or soil conditioner, contemplates an x value that is higher than that specified in claim 9 (i.e., 0.5 to 10)(see column 2 at line 66). Noweck discloses a process of producing high purity hydrotalcites which are stratiform, anionic mexed metal hydroxides of the general formula:

$$M_{2x}^{2+}M_2^{3+}(OH)_{4x-4}A_2/n^{n-}zH_2O$$

where M_{2x}^{2+}, M_2^{3+} are divalent and trivalent metals respectively, x ranges from 0.5 to 10 in intervals of 0.5, A is an organic interstitial anion, n is the charge of the interstitial anion, and z is an integer of 1 to 6. In contrast, the claimed fertilizer and soil conditioner only exits when x ranges from 0.1 to 0.5 (thus Noweck is not within the scope of what one of ordinary skill in the art would consider). Also, the organic interstitial anion in Noweck is different in comparison to the NO_3^-, Cl^-, SO_4^{2-} or HCO_3 ions of the claimed invention. Noweck is directed to using the inorganic ion-exchange materials and mole seives as anticarious additives for tooth pastes, or as antacids, and as additives for plastics, e.g., flame retardants and yellowing inhibitors for PVC, and use in resisting vibrations. Noweck includes no indications for using as a fertilizer and long term soil conditioner.

Claims 9, 10, 18, 20, 21, and 23-28 were rejected as being anticipated by or being obvious over U.S. Patent 5,750,609 to Nosu. This rejection is traversed. Nosu describes an ultraviolet protective agent which comprises fine particles of zinc compound represented by the general formula:

$(Zn_yM^{2+}_z)_{1-x}M^{3+}_xO_{1+x/2}$

wherein M^{2+} is at least one metal selected from the group consisting of Mg, Ca, Ni, and Cu, and M^{3+} is at least one metal selected from the group consisting of Al and Fe, and x, y, and z each satisfy $0.2 \leq x \leq 0.4$, $(y+z)=1$, and $0 \leq z \leq 0.75$. In Nosu, no water is available in the compound (water is required in claim 9 of the present application). Furthermore, Nosu does not suggest use of the LDH as a fertilizer or soil conditioner.

Claims 9, 10, 18, 20, 21, 23-26 and 28 were rejected as being anticipated by U.S. Patent 5,079,203 to Pinnavaia. This rejection is traversed. Pinnavia is related to an intercalated uniform crystalline layered double hydroxide clay composition conforming to the formula

$[M^{2+}_{1-x}M^{3+}_x(OH)_2]A^{n-}_{x/n} \bullet yH_2O$

wherein M^{2+} is a divalent metal and M^{3+} is a trivalent metal, A is a polyoxometalate anion of charge –, x is between 0.12 and 8 and provides pillar height greater than about 9 Angstromss and an x-ray diffraction basal spacing value greater than 14 Angstroms. As will be recognized by those of skill in the art, the polyoxometalate anion of Pinnavia is different in comparison to the nitrate, sulfate, chloride or hydroxide anion specified in claim 9. Polyoxalates are polymeric oxoanions formed by condensation of more than two kinds of axoanions. The most common structural feature is the "Keggin" anion. This anion is used as a heterogenous catalyst.

Claims 9-11, 18, 20, 21, and 23-28 have been rejected as being anticipated by or being obvious over U.S. Patent 5,976,401 to Suzuki. This rejection is traversed. Suzuki discloses an agent for removing phosphates, nitrates, and nitrites from waste water comprising a metal hydroxide complex as a phosphate adsorbent represented by the formula:

$M^{2+}_{1-x}M^{3+}_x(OH^-)_{2+x+y}(A^{n-})_{y/n}$

wherein M^{2+} is at least one divalent metal ion selected from Mg, Ni, Zn, Fe, Ca, and Cu, M^{3+} is at least one trivalent metal ion selected from Al and Fe, A^{n-} is an n-valent anion, x ranges from 0.1 to 0.5 and y ranges from 0.1 to 0.5, and n is 1 to 2. As such, Suzuki does not meet the claimed formulation. Further, the Suzuki metal oxide is water free, and claim 9 requires the presence of water.

Claims 12-14 have been rejected as being obvious over the references of

record in further view of Henning (IP 326110A1), U.S. Patent 4,396,412 to Heller and U.S. Patent 4,753,035 to Ryan. This rejection is traversed. As noted above, claims12 and 13 and 14 particularly highlight the fact that the claimed invention is a fertilizer and soil conditioner by requiring the presence of other fertilizers, seeds, seedlings or propagation elements. None of the prior art references, as noted above, are directed to a fertilizer and soil conditioner. The cited secondary references do not make up for the deficiencies of the previously discussed references. In particular, Henning is concerned with influencing the growth of potted plants in window boxes and plants in containers of horticultural businesses which uses natural minerals such as the clay mineral bentonit with a high swelling capacity. Bentonit has at least three layers which include silicon- and oxygen-tetraeder and octahderon from groups of oxygen and OH^-. The alumina in the octahedron can be substituted by ferrum or magnesium, and it is possible to intercalate nutrients such as mineral fertilizer in the intermediate later. Henning is based on the task of optimizing the growth in potted plants, plants in window boxes and plants in plant containers in horiticultural businesses over a long period of time through controlled feeding of nutrients and to buffer ovcerfertilization by overwatering with nutrient solutions. In contrast the fertilizer and soil conditioner preparation of the present invention includes an LDH which is a synthetic compound which has a layer of Me^{2+} and Me^{3+} and a NO_3^-, Cl^-, SO_4^{2-}, or HCO_3^- interlayer. Bentonit is a natural compound, not a synthetic, and has predetermined properties which are different from those of the claimed invention. Furthermore, the aim of the claimed invention is to provide a fertilizer and soil conditioner preparation that is able to exchange nitrate in the soil. This means the LDH has to adsorbe nitrate from the soil solution to prevent nitrate leaching into deeper soil layers. Bentonit does not exhibit this high selectivity for nitrate (nor do any of the other references of record). Ryan discloses a method for obtaining botanic seeds, seedlins, meristematic tissue, and plant embryos coated with a cured silicone coating. Ryan is intended to provide a technique whereby cultivated plant tissue or seeds or seedlings or plant embryos are insulated from harmful conditions. Ryan does not disclose, as none of the other references of record disclose, a slow release fertilizer and long term soil conditioner, and, as such, no combination of the references would make the claimed invention obvious to one of ordinary skill

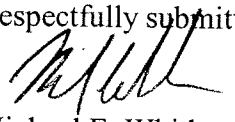
in the art. Heller is related to a process for improving plant growth with the aid of an ion exchanger fertilizer. The ion exchanger is charged with an anionic chelate complex of micronutrient cations and macronutrient anions. Anionic chelate complexes belong to the ionic exchange resins. Heller does not show or suggest use of the LDH specified in the claims as required for the new and inventive fertilizer and soil conditioner of the claimed invention. In comparison, the LDH used in the fertilizer and soil condition of the claimed invention has a completely different structure than the ionic exchanger of Heller. Thus, there is no motivation in Heller or any of the other references of record which relate to LDH materials, that an LDH material can be used for slow release fertilization and soil conditioning.

In view of the foregoing, it is respectfully requested that the application be reconsidered, that claims 9-15, 18, 19, and 25-28 be allowed, and that the application be passed to issue.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

A provisional petition is hereby made for any extension of time necessary for the continued pendency during the life of this application. Please charge any fees for such provisional petition and any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041.

Respectfully submitted,



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